REMARKS

Claims 1- 20 were originally filed in the parent application Ser. No. 09/928,769.

New claims 21-22 were added in a response to the first office action dated July 2, 2002.

In a Request for Continuing Examination, claims 23-48 were added. Claims 31-48 were

subject to a Restriction requirement.

In the present application (filed as a divisional application), claims 1-20 of the

parent application were canceled and new claims 21-38 were added in a preliminary

amendment filed concurrently with the application. The new filed claims were

substantially claims 31-48 of the parent application that were subject to a restriction

requirement. All amendments made to the specification in the preliminary amendment

filed on January 14, 2004 were also made in the parent application.

In the present document, independent claim 21 has been amended to clarify the

claim language and to resolve an ambiguity noted by the Examiner. Dependent claims

23-28, 32, 34, 35 and 38 have been amended to make their language consistent with that

of amended claim 21.

No new matter has been added by the amendments. Reconsideration of the

application as amended is respectfully requested. The Examiner's rejections are

addressed in substantially the same order as in the referenced office action.

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REJECTIONS UNDER 35 USC §102

Claims 21, 22, 23, 25, 26 and 30 stand rejected under 35 USC§ 102 as being

anticipated by the article "The Petrophysics of Electrically Anisotropic Reservoirs" by

Klein et. al. Claim 21 is an independent claim.

The present invention is a method of petrophysical evaluation of an earth

formation using measurements of horizontal and vertical resistivity of the earth formation

made by a logging tool. Using a measured horizontal resistivity and a vertical resistivity,

a horizontal permeability and a vertical permeability are determined. The ratio of the

horizontal and vertical permeabilities is different from the ratio of the horizontal and

vertical resistivities.

As the Examiner has pointed out, the ratio of the horizontal to vertical

permeability shown in Figures 7, 8, 10 and 11 of *Klein* are different from the ratio of the

horizontal and vertical resistivities.

The Examiner appears to have misunderstood how the figures 7, 8, 10 and 11 in

Klein were derived. Attention is drawn to Eqns. (4) and (5) of *Klein*. This is the basis

for determining vertical and horizontal resistivities $R_\perp$ and $R_{//}$. These are determined

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from the porosity ϕ, volume fractions V_M and V_μ of a two component mixture, the Archie

coefficients a, m and n, the water saturation S_w and the water resistivity R_w. Mercury

injection capillary pressure data (MICP), (from **Fig. 1a**) are used (**see page 26 col. 2**) to

get the water saturation of each lithology as a function of pressure and then get the

resistivity ratio plotted in **Fig. 1b**. *Klein* further compares the results of **Fig. 1b** with

actual laboratory measurements made on a rock sample (**Fig. 2**) and concludes that the

"laboratory-derived resistivity ratios increase with decreasing saturation as predicted by

our model." **Page 27 col. 2.**

Turning next to **Fig. 5** of *Klein*, we note that this represents a petrophysical model

for the A-sand of a prospect in the Kuparuk area derived from log and core data. Note

that the model is based on Formation Microscanner data from Well C, which is nearly

vertical. (**page 27 col. 2 last line- page 29 col. 1, lines 1-2**). A single resistivity log is

shown in track 4 of Fig. 6. The manner in which the other logs in Fig. 6 were obtained

are generally discussed at **page 29 col. 1 line 5 – page 29 col. 2 line 7. This means that**

the permeability logs shown in tracks 7-9 of Figure 6 were derived from a single

resistivity log.

Turning now to **Fig. 7**, we note the following at **page 29, col. 2 line 12** in *Klein*:

"The detailed logs shown in Figure 6 were next averaged with a running filter to

simulate logging tools with vertical resolution of approximately 2 ft. with results

shown in Figure 7 and 8. We averaged the high-resolution log both in parallel

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and   in series to obtain simulated parallel and perpendicular resistivity logs. The
results are shown for two different values of FWL. The first case shown in Figure
7, has FWL at depth 7,200 ft..... The permeability logs shown in Figure 7 are
parallel and perpendicular permeability to oil"

In other words, the parallel and perpendicular resistivity logs shown in tracks 3
and 4 of Figure 7 are **simulated logs derived from the single resistivity log of Figure 6.
The parallel and perpendicular permeability shown in tracks 6 and 7 of Figure 7 are
derived from the ko (in track 7 of Figure 6) which in turn is derived from the single
resistivity log in track 4 of Figure 6.**

> "We averaged the detailed resistivity log both in parallel and in series to obtain parallel and
> perpendicular resistivity logs."

It is further noted that the material in the *Klein* reference is substantially the same
as the material in a paper presented by *Klein* with the same title at the SPWLA Logging
Symposium held on June 26-29, 1995 and cited in an accompanying Supplementary IDS.
Applicant interprets the single resistivity log to consist of measurements made by a
conventional logging tool which, in 1995 (and even in 1997), would consist only of
horizontal resistivity measurements. Applicant requests the Examiner to take judicial
notice of the fact that the transverse induction logging tools necessary for making a
measurement of a vertical resistivity were not known at the time of publication of *Klein.*
Furthermore, only a *single* log is disclosed as being measured, so it could not be used to
provide *both* a horizontal resistivity and a vertical resistivity.

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Figure 8 is similar to Figure 7 with a different FWL.

Figure 9 and 10 are similar to figures 6 and 7 for a different model (Gulf Coast, instead of Kuparuk).

Claim 21 includes the determination of a horizontal and a vertical permeability from a horizontal resistivity **and** a vertical resistivity. As noted above, the teachings of *Klein* with reference to Figure 6 and 7, there is no teaching of deriving a horizontal permeability and a vertical permeability from a horizontal resistivity and a vertical resistivity: all that is disclosed is a derivation of a plurality of values of horizontal permeability and a plurality of values of a vertical permeability from a plurality of values of a single (horizontal) resistivity.

In order for a claimed invention to be anticipated by a single prior art reference, the prior art reference must disclose each and every limitation of the claim arranged as in the claim. This requirement is clearly lacking in the present case. Accordingly, applicant respectfully submits that claim 21 and claims 22-38 that depend upon claim 21 are patentable under 35 USC § 102 over *Klein.*

None of the prior art of record teaches or suggests the specific limitations of claim 1 discussed above. Accordingly, applicant further submits that claim 21 and claims 22-38 that depend upon claim 21 are also patentable under 35 USC § 103 over *Klein* and the prior art of record.

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REJECTIONS UNDER 35 USC § 103

Claims 27, 28, 32, 33, 34 and 37 stand rejected under 35 USC § 103 over *Klein*.

This issue has been addressed above in the rejection under 35 USC§102 over *Klein*.

The Examiner asserts in ¶ 26 of the office action with reference to claim 27 that "it would have been obvious to one of ordinary skill in the art at the time the invention was made that a conventional logging while drilling device which acquires transverse/perpendicular resistivity as well as parallel longitudinal resistivity is a 'transverse' logging induction tool." Nothing could be further from the truth—a conventional logging while drilling device **does not** acquire transverse as well as parallel longitudinal resistivity. A conventional logging tool only has antenna coils that have an axis parallel to the tool axis and can only make measurements of horizontal resistivity. A transverse induction tool has an antenna with a coil transverse to the tool axis. The cited portion of *Klein* (page 25 col. 2 last paragraph) only gives equations relating the horizontal resistivity and vertical resistivity of a laminated sequence to the resistivity of the individual layers of the sequence. It **does not** disclose a device to make such measurements.

Claims 27 stands rejected under 35 USC§103 over *Klein* in view of *Hagiwara* (US5966013). The Examiner has cited **col. 3 lines 16-20** for supporting her contention that a transverse induction tool is taught. Applicant respectfully disagrees. The portion of *Hagiwara* cited by the Examiner includes the following:

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"These induction type resistivity measurements may be a combination of induction log R and X

resistivity measurements; the phase and attenuation derived resistivities from a 2 MHz LWD type

induction log; the phase or attenuation resistivities from a 2 MHz LWD resistivity logs measured

using two different transmitter-receiver pair spacings; the phase or attenuation resistivities from a

2   MHz induction-type resistivity log taken at two different frequencies; or an induction log

resistivity and LWD induction-type log resistivity."

There is no teaching of a transverse induction logging tool. All that is disclosed is

an "induction logging tool 85, which is a conventional induction type logging tool,

includes a transmitting antenna T_1, and a pair of receiving antennas R_1 and R_2 mounted

on a section of a drill collar 120." See col. 5 lines 62-66.

We further note that col. 3 lines 16-20 and the following portion col. 3 lines 22-

30 describe how measurements of horizontal and vertical resistivities may be obtained in

a deviated borehole using a convention induction logging tool. This is not a teaching of a

transverse induction tool

Applicant further notes the Examiner's reference to *Dussan* (US5463549) in ¶ 11

of the office action ane assertion that "Dussan V. et al determines horizontal and vertical

permeabilities from multiple radial resistivity measurements (i.e., horizontal/vertical

resistivity depending upon the frame of reference) which are performed at different

resistivity depths". Applicant respectfully disagrees with the Examiner's assertion that

multiple radial measurements give horizontal/vertical resistivity. *Dussan* refers to "A
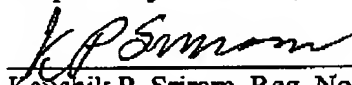
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single device which obtains measurements at several radial depths of investigation is the

so-called Array Induction Tool or "AIT" which imploys an array of induction coils and a

signal processing in the obtainment of its resistivity measurements. Reference can be

made, for example to U.S. Pat. No. 4,873,488..."

Applicant has reviewed US4873488 to *Barber* (submitted in the accompanying

IDS) and it is **not** capable of providing horizontal and vertical measurements. Contrary

to the Examiner's assertion, measurements of a single component of resistivity **does not**

provide measurements of two components of resistivity.

The Commissioner is authorized to charge any fees for these amendments to

Deposit Account 02--0429 (584-23131-USD).

Respectfully submitted,

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